Art. XIV.—*Note on a Basalt Tree Cast.*

By R. H. WALCOTT, F.G.S.

(With Plate XIII),

[Read 13th July, 1899].

In the Industrial and Technological Museum Collection there is a specimen which perhaps stands unique as a remarkable geological curiosity. It is what appears to be the cast of a tree in basalt which was found in the quarry of Mr. John White, at Footscray, by whom it was exhibited at the Melbourne Intercolonial Exhibition of 1866. Along with many other objects from that Exhibition it was presented to the Trustees of the Public Library and assisted in forming a nucleus for the present Museum Collection. Unavoidably the specimen was broken into many pieces in removing it from the hard enclosing basalt and consequently it remained in an obscure corner of the old building for many years, an unsightly object attracting but little attention. On the removal of the collection to the New Museum, the late Superintendent had each section properly secured in its original position by stout iron pins and cement, so that the true nature of the specimen is now plainly revealed. The restoration has been the means of considerably increasing the amount of interest previously taken in the exhibit but without evolving any more feasible theory for its origin than that already advanced.

The tree consists of a slightly curved stem with an average circumference of 31 inches, the top or point of branching being only $1\frac{1}{2}$ inches less than that near the root junction at which point the stem is abruptly constricted.

It is supported on several short roots, or better perhaps, portions of roots, and carries one branch $4\frac{1}{2}$ feet long.

The branch, which is also slightly curved, has an average circumference of about 19 inches with a small taper, the end being rounded off. It diverges from the vertical at an angle of about 30 degrees. At the branch junction the stem bears two depressions, one being large and situated on the top of the stem,

the other smaller and carried on a prominence at the side. Both these structures are evidently scars left by old limbs which were lost long before the advent of the lava streams. From the larger depression a groove, becoming gradually shallower, extends downwards, and on the opposite side a similar but smaller groove appears. The vertical height of the tree from roots to tip of branch is 10 feet. The surface bears a number of corrugations and has the identical appearance of bark. The basalt of which the tree is composed seems to be of the ordinary vesicular variety and calls for no special notice. Its nature is evident from a macroscopic examination, and a microscopic investigation was deemed unnecessary and valueless. On one side of the stem a portion is seen to be composed of a different material. It forms a crust about $\frac{3}{8}$ of an inch in the thickest part and consists of quartz sand, clay and calcium carbonate. Where intact the surface of this crust is indistinguishable from the remainder and the basalt underneath is comparatively smooth and exhibits none of the characteristics observed elsewhere. The surrounding basalt comprising the mould in which the tree was formed, judging from the two available pieces, is to all appearances of the same nature as the cast. It has a light coloured coating and shows very distinctly an impress as of bark. The latter fact supports strongly the contention that the specimen is a cast and not a result of concretionary action.

In dealing with this subject care must be taken not to confuse it with what are generally known as fossil or petrified trees. These are comparatively common and are the result of a gradual replacement of the organic material of the trees by some mineral substance, usually silica, derived from the circulation of waters holding it in solution. Tree petrifactions are so complete in some instances that the woody structure is preserved in perfect detail; they are in fact pseudomorphs by substitution, bearing the form and structure of wood but possessing a mineral instead of an organic composition. In the present instance, however, the original body has first been entirely removed, leaving a cavity or mould which has been subsequently filled by a molten mass of lava. The cast retains the external appearance of a tree but is quite devoid of all other similarity, the interior only showing a basaltic structure.

Mr. Brough Smyth[1] refers to this specimen but hesitates to give an opinion on such an occurrence, as the imitative forms approach so closely to the natural. He mentions the behaviour of lava currents in wooded districts as described by Mr. Dana[2] in his account of the Kilauea Eruption of 1840. As this has a direct bearing upon the subject it will be of interest to repeat it here :

"The lava sometimes, as in other eruptions, flowed round stumps of trees; and as the tree was gradually consumed it left a deep cylindrical hole, either empty or filled with charcoal. Towards the margin of the stream these stump-holes were innumerable; and in many instances the fallen top lay near by, dead but not burned. . . . . .

"The rapidity with which lava cools is still more remarkably shown in the fact that it was found sometimes hanging in stalactites from branches of trees; and although so fluid when thrown off from the stream as to clasp the branch, the heat had barely scorched the bark."

This being an authentic record of the formation of tree moulds in lava, it is perfectly reasonable to assume that had another flow spread over this one at a later period, a number of casts similar to the one under discussion would have resulted.

With regard to the point mentioned by Mr. Brough Smyth that imitative forms at times closely approximate to the natural, it must be observed that nearly all such forms are noted in sedimentary rocks when they are mostly due to the segregation of mineral matter taking place after the formation of the rock itself. Concretions in the true sense, I believe, are practically unknown in undecomposed volcanic rocks. At times, especially in slow flowing lavas, their surfaces exhibit peculiar ropy and other forms produced by the molten lava in the interior moving more rapidly than that at the surface and causing the chilled crust to twist and wrinkle. This structure, however, is quite foreign to the case in view and merely mentioned as being practically the only forms of lava possessed of anything approaching an imitative character. As this is the only alternative

---

1 "Gold Fields and Mineral Districts of Victoria," 1869, footnote page 51.

2 "Characteristics of Volcanoes." James D. Dana, 1890 ed., page 64.

suggestion brought forward, we may I think, safely reject it and accept the cast theory as being perfectly satisfactory and consistent with observed occurrences. It is certainly an isolated example, as far as can be ascertained, but when we consider the small extent of quarrying to which lava flows have been subjected and the unusual conditions necessary for the production of basalt tree casts that fact should not influence our acceptance of this explanation.

In the absence of authentic data we must be guided by the features which the specimen itself offers, in attempting to trace out the history of its formation.

In the first place a necessary condition for the preservation of the tree form would lie in its being rapidly surrounded by the molten lava so that the carbonized remains would be inaccessible to the air, and maintain the mould in its proper shape until the lava had cooled sufficiently to prevent it from closing in. This implies a rather fluid state of the lava, because, had it been a viscid mass slowly advancing, it is probable that the tree would have been completely destroyed before it was enveloped and protected from this otherwise inevitable fate. Close examination of the specimen does not reveal any point which can be satisfactorily considered as representative of the lava inlet to the mould. It is therefore not quite evident what position the tree occupied when it was ingulfed in the rapidly flowing lava stream. If the superficial crust previously mentioned can be taken as an integral part of the cast, although of different composition, it must be composed of detrital matter which has been carried mechanically into the mould during the interval which elapsed between the successive lava flows, and after the charred remnants of the tree had been removed. It is certainly not a decomposition product of basalt, the quartz grains being of course quite foreign to that rock, and, moreover, the crust is sharply defined and easily detached from the stem without showing the usual gradation of decomposition, so that it must have been derived from some outside source. Should this view be correct, then the tree must have been in a more or less horizontal position, for had it retained its upright position any detrital matter would naturally have gravitated to the bottom of the mould and formed the lower part of the root cast. In order to provide an entrance

for the lava to the mould we have two alternatives; either the first flow could not have completely covered the tree leaving some portion projecting above the surface as exemplified at Kilauea, or else the tree was completely covered by perhaps many feet of basalt, which has in the course of time through denudation been gradually removed until the mould was reached and rendered accessible to the succeeding flow. The latter view does not seem probable, because even provided that the charred remains of the tree were removed from the cavity the products of decomposition and detritus from the surface would have to a large extent, if not completely, filled it and prevented anything like a perfect cast being formed. Besides this, by the time the mould was reached decomposition of the basalt forming it would in all probability have advanced so far as to destroy the clearness of the mould. The first alternative seems most satisfactory and presuming that the tree occupied a horizontal position it would mean that the lava sheet could only have attained a thickness of about 2 feet at the point where the tree was buried, and even if an upright position had been maintained its thickness could not have been more than 10 feet. Molten lava streams obey the laws of all liquid bodies and, therefore, in their movements resemble water-courses, following valleys and forming streams of sometimes great thickness, where the country is hilly or mountainous, and flooding it when it assumes a slightly undulating or level character. The tree may then have been growing in comparatively flat country, or on an eminence when it was borne down upon by a flow of molten lava, and unable to withstand the weight of the advancing mass was forced down before it breaking its roots off short by the stem and then rapidly being almost covered by the flow. The length of time which then elapsed, during which the mould became freed of the carbonized remains of the tree, and the advent of the succeeding flow in the absence of authentic data are problems difficult to explain. It may have happened that the tree remains slowly smouldered away, a supposition entailing a coolness of the basalt in the immediate vicinity of the mould, which otherwise would have rapidly closed. We have seen that lava in a highly molten state thrown on to tree branches has done no more than scorch the bark, and also that tops of trees which have been enveloped

by lava lay on the surface dead but not burned. No doubt cooling is very rapid at the surface of the flows or when lava occurs in small isolated masses, but it is a well known fact that lava remains molten at a short distance from the surface for a very considerable time. At Vesuvius it is commonly observed that the lava is glowing hot a few inches from the surface long after the flow has taken place although the surface itself can be walked on with impunity. Probably contact with the tree would be sufficient to cause a local cooling assisted further by the porosity of the charcoal permitting access of air. We must also remember that it is assumed that the flow at this point was comparatively thin, perhaps attaining only a few feet in thickness, and that it was cooling both from top and bottom so that it is quite likely the flows succeeded one another within a comparatively short time and before much debris had accumulated in the mould. Most of these points might have been settled by the proprietor of the quarry, but up to the present enquiries for him have been fruitless and I have not yet been able to locate the quarry, nevertheless this note will at least serve as a record of this interesting occurrence.